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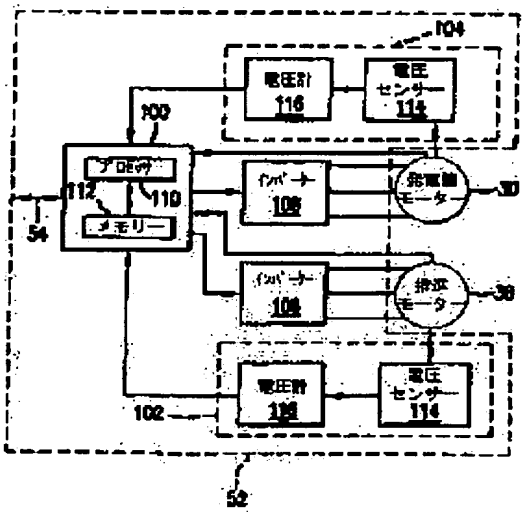
(54) COUNTERMEASURE FOR DEMAGNETIZATION OF MOTOR OF ELECTRIC MOTORCAR

(57)Abstract:
PROBLEM TO BE SOLVED: To take countermeasures by monitoring the deterioration of demagnetization of a magnet in a motor.
SOLUTION: In an electric motorcar or a hybrid motorcar, a voltage monitor 102 is connected to a propulsive motor 38 and/or a generator motor 30, and detects the voltage induced by the permanent magnet within the motor, in the conditions of specified speed and no-load. A controller 100 compares the detected voltage induced by the permanent magnet with estimated reference voltage, which expresses the voltage induced by the permanent magnet estimated in a state of complete magnetization at a specified speed. The controller 100 generates the indication of magnetism, based on the reference voltage, the detected voltage induced by the permanent magnet, and the specified speed. When the indication of the magnetism reaches a specified threshold, the motor is disabled, to avoid damaging parts. Then, the current to the motor is limited, as required. It is preferable that the user of a vehicle be made to recognize these actions by a visible or audible indicator. When it is usable, another power source is used, in place of the disabled motor.



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CLAIMS

[Claim(s)]
[Claim 1] The permanent magnet induced voltage monitor which detects the permanent magnet induced voltage of a motor in a predetermined rate, And it compares with the reference voltage reflecting the permanent magnet induced voltage of a motor with the permanent magnet completely magnetized in the permanent magnet induced voltage detected in the above-mentioned predetermined rate. Equipment which judges the magnetic condition of the permanent magnet of the above-mentioned motor based on the permanent magnet induced voltage and reference voltage by which detection was carried out [above-mentioned], and is adapted for the demagnetization of the magnet in the motor of a car which has the treater which restricts the current supplied to the above-mentioned motor based on this magnetic condition.
[Claim 2] Equipment of claim 1 with which the above-mentioned permanent magnet induced voltage monitor has the voltmeter connected to the stator of the above-mentioned motor at the above-mentioned coil in order to detect the above-mentioned permanent magnet induced voltage, a coil and.
[Claim 3] Equipment of claim 1 with which the above-mentioned permanent magnet induced voltage monitor measures permanent magnet induced voltage by unloaded condition.
[Claim 4] Equipment of claim 1 with which the above-mentioned treater restricts the amount of the current supplied to the above-mentioned motor after the above-mentioned magnetic condition reaches a predetermined threshold.
[Claim 5] Equipment of claim 3 with which the above-mentioned permanent magnet induced voltage is detected when the contact of the inverter which supplies a current to the above-mentioned motor has opened wide.
[Claim 6] Equipment of claim 3 with which the amount of the current supplied to the above-mentioned motor is restricted to the amount of currents safe for the components of the above-mentioned car.
[Claim 7] Equipment of claim 1 whose above-mentioned motor is a generator motor connected to the promotion motor connected to the wheel of the above-mentioned car or the epicyclic gear, and the above-mentioned wheel.
[Claim 8] The step which detects the permanent magnet induced voltage of the above-mentioned motor which is the approach of coping with degradation of the permanent magnet in the motor of a car, and is operating at the rate of predetermined, When the permanent magnet in the above-mentioned motor is magnetized completely, the above-mentioned permanent magnet induced voltage The step in comparison with the reference voltage showing the permanent magnet induced voltage expected by the above-mentioned motor, How to have the step which judges the magnetic condition of the permanent magnet of the above-mentioned motor, and the step which restricts the amount of the current supplied to the above-mentioned motor based on the above-mentioned magnetic condition based on the above-mentioned permanent magnet induced voltage, the above-mentioned reference voltage, and the above-mentioned predetermined rate.
[Claim 9] The approach of claim 8 which has further the step memorized in order to refer to the above-mentioned magnetic condition in the future.
[Claim 10] The approach of claim 8 that the step which detects the above-mentioned permanent magnet induced voltage has further the step which guides an electrical potential difference to the coil which adjoins the stator of the above-mentioned motor and is located.
[Claim 11] The step which detects the above-mentioned permanent magnet induced voltage is the approach of claim 10 of detecting the above-mentioned permanent magnet induced voltage by unloaded condition.
[Claim 12] The step which restricts the amount of currents to the above-mentioned motor is the approach of claim 9 of restricting the current to the above-mentioned motor after the above-mentioned magnetic condition reaches a predetermined threshold.

[Claim 13] The approach of claim 9 which has further the step which generates a visible or audible display when the above-mentioned magnetic condition is less than a predetermined threshold.
[Claim 14] The step which detects the above-mentioned permanent magnet induced voltage is the approach of claim 11 that the above-mentioned car detects the above-mentioned permanent magnet induced voltage during an idle or stationary transit.
[Claim 15] In order to judge the 1st permanent magnet induced voltage of a promotion motor, a generator motor, and the above-mentioned promotion motor In order to judge the 2nd permanent magnet induced voltage of the 1st voltage monitor and the above-mentioned generator motor which were connected to the above-mentioned promotion motor When the permanent magnet of the above-mentioned promotion motor is magnetized completely, the 2nd voltage monitor connected to the above-mentioned generator motor, and the above-mentioned 1st permanent magnet induced voltage When the permanent magnet of the above-mentioned generator motor is completely magnetized in the above-mentioned 2nd permanent magnet induced voltage as compared with the 1st reference voltage reflecting the permanent magnet induced voltage expected about the above-mentioned promotion motor It compares with the 2nd reference voltage reflecting the permanent magnet induced voltage expected about the above-mentioned generator motor. The predetermined rate at the time of the above-mentioned 1st permanent magnet induced voltage, the 1st reference voltage of the above, and the above-mentioned 1st permanent magnet induced voltage being judged, It is alike, and is based and the magnetic condition of the permanent magnet of the above-mentioned promotion motor is judged. The above-mentioned 2nd permanent magnet induced voltage, The predetermined rate at the time of the 2nd reference voltage of the above and the above-mentioned 2nd permanent magnet induced voltage being judged, It is alike and are based, and judge the magnetic condition of the permanent magnet of the above-mentioned generator motor, and it is based on at least one of the magnetic condition of the above-mentioned generator motor, and the magnetic conditions of the above-mentioned promotion motor. The hybrid electric vehicle which adjusts at least one current of the above-mentioned generator motor and the above-mentioned promotion motor and which has a controller.
[Claim 16] The automobile of claim 15 which has the sensor coil with which the 1st voltage monitor of the above detects the 1st permanent magnet induced voltage guided by rotation of the rotor containing the permanent magnet of the above-mentioned promotion motor, and has the sensor coil with which the 2nd voltage monitor of the above detects the 2nd permanent magnet induced voltage guided by rotation of the rotor containing the permanent magnet of the above-mentioned generator motor.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Specifically, this invention relates to the cure against degradation of the permanent magnet in the motor/generator in a hybrid electric vehicle and an electric vehicle about a hybrid electric vehicle (carrying out hybrid electric vehicle abbreviation HEV) and an electric vehicle roughly.
[0002]
[Description of the Prior Art] The need of reducing the fossil fuel consumption and the discharges in a car, such as an automobile mainly driven with an internal combustion engine (carrying out Internal Combustion Engine abbreviation ICE), is known well. The car driven by the electric motor copes with such need. The thing of combining small ICE with one car with an electric motor is known as another solution. Such a car combines the advantage of an ICE car and an electric vehicle, and, generally is called the hybrid electric vehicle (carrying out HybridElectric Vehicle abbreviation HEV) (patent reference 1 reference).
[0003] About HEV, various configurations are well-known. In one of such the configurations, an electric motor drives the wheel of a lot and is driving group with another ICE. Moreover, other more useful configurations have been developed. For example, a series hybrid electric vehicle (carrying out Series Hybrid Electric Vehicle abbreviation SHEV) is the car by which the engine (most generally ICE) was connected to the electric motor called a generator. And a generator supplies power to another motor called a dc-battery and a promotion motor. It sets to SHEV and a promotion motor is the only generation source of wheel torque. There is no mechanical association between an engine and a driving wheel. The configuration of a parallel hybrid electric vehicle (carrying out Parallel Hybrid Electrical Vehicle abbreviation PHEV) has the engine (most generally ICE) which collaborates in various degrees in order to give wheel torque required to drive a car, and an electric motor. In addition, in a PHEV configuration, it can use as a generator for charging a dc-battery using the power with which ICE generated this motor.
[0004] Parallel / series hybrid electric vehicle (carrying out Parallel/Series Hybrid Electric Vehicle abbreviation PSHEV) has the description of the configuration of both PHEV and SHEV, and may be called a "split (split)" configuration. In one of the formats of PSHEV which exists partly, ICE is mechanically combined with two electric motors in the transformer axle of one epicyclic gear device. The generator which is the 1st electric motor is combined with Sun Geer. ICE is combined with a carrier. The promotion motor which is the 2nd electric motor is combined with a ring (output) gear through another gearing device in a transformer axle. An engine torque can give power to a generator, in order to charge a dc-battery. A generator can be contributed to required wheel (output shaft) torque again, when a system has an one-way clutch. A promotion motor is used, in order to contribute to wheel torque, to charge a dc-battery and to collect braking energy. In this configuration, a generator can offer alternatively the reaction torque which can be used in order to control an engine speed. An engine, a generator motor, and a promotion motor can actually offer an operation of an unapproved change gear (carrying out continuous variable transmission abbreviation CVT). Furthermore, HEV can control an idle rate by using a generator for controlling an engine speed better than the usual car.
[0005] A generator motor and a promotion motor contain a permanent magnet. These permanent magnets may be deteriorated or demagnetized with the passage of time by temperature, the high ripple current, the power ripple, vibration, and long term deterioration while demagnetizing them accidentally. This demagnetization may reduce car engine performance, such as output power / torque, and effectiveness. Demagnetization may progress to extent from which safety poses a problem. Although a wheel is more specifically driven in important scenes, such as passing, as a result of demagnetization, available torque may decrease. Moreover, as a result of demagnetization, energy available to regenerative braking may become

small, and it may have bad effect on stopping distance/time amount.
[0006] The patent reference 2 is related with the control unit for a convex pole mold permanent magnet motor. The purpose of this equipment is to prevent torque falling by magnetic demagnetization. The magnetic flux of a permanent magnet is calculated or presumed by judging the electromotive force of a permanent magnet according to the electrical potential difference supplied to a permanent magnet motor, a current and the rotational speed of a motor, and the inductance of a permanent magnet motor. This electromotive force is measured with the criteria electromotive force showing the permanent magnet magnetized completely. This processing is complicated and complicated. The direct detection of demagnetization by using a sensor of a certain kind like a hall device or a magnetic resistance element is suggested to the above-mentioned patent reference 2. While the approach of the direct detection suggested to this patent is comparatively expensive, serviceability is affected by arranging a complicated sensor in a motor case. Moreover, the monitor report of the demagnetization exceeding safety clearance is not necessarily carried out for an insurance-related cure.
[0007]
[Patent reference 1] U.S. Pat. No. 5,343,970 number
[Patent reference 2] U.S. Pat. No. 5,650,706 number
[0008]
[Problem(s) to be Solved by the Invention] Then, magnetic degradation of a permanent magnet is supervised and the need of receiving the approach and equipment which take the measures and which were improved exists.
[0009] Therefore, the purpose of this invention is offering the degradation monitor of the permanent magnet for an electric vehicle or a hybrid electric vehicle (HEV).
[0010] Another purpose of this invention is offering the safe and direct method of judging the magnetic flux of the permanent magnet in a motor.
[0011] Still more nearly another purpose of this invention is judging the magnetic condition of a permanent magnet, in order to adjust the torque of the motor of a car.
[0012] Purpose of this invention another again is offering the adaptive control which copes with permanent magnet degradation including protection of components, an operation limit, and the information of permanent magnet degradation to the user of a car.
[0013] Other purposes of this invention will become clearer to this contractor of the field to which this invention belongs by reading the following explanation with reference to an attached drawing.
[0014]
[Means for Solving the Problem] According to one of the viewpoints of this invention, the equipment which copes with degradation of the permanent magnet in the motor of a car is offered. This equipment contains the voltage monitor which detects the permanent magnet induced voltage within the above-mentioned motor in the state of a predetermined rate and no-load. This voltage monitor receives permanent magnet induced voltage, and is connected to the treater in comparison with the reference voltage reflecting the permanent magnet induced voltage of a motor with the permanent magnet completely magnetized in this permanent magnet induced voltage. This treater judges the magnetic display of a permanent magnet as a function of the detected permanent magnet induced voltage, reference voltage, and a predetermined rate. When a magnetic display reaches a predetermined threshold, in order to prevent the damage to components, a motor is made into impossible of operation, and/or the current to a motor is restricted. Preferably, the motor was made into impossible of operation, or/or an audible drop reports visible and a working thing to the user of a car in limit mode. Another source of power which are another desirable for example, motor, internal combustion engines, or those combination is considered as instead of [of the motor made into impossible of operation].
[0015] According to another viewpoint of this invention, the approach of being adapted for degradation of the permanent magnet in the motor of a car is offered. The permanent magnet (carrying out permanent magnet abbreviation PM) induced voltage of a motor is detected first. Permanent magnet induced voltage is detected by guiding an electrical potential difference to the coil wound around the gear tooth of the stator of a motor preferably. An electrical potential difference is guided by rotation of the rotor containing a permanent magnet in a predetermined rate. The detected permanent magnet induced voltage is compared with the reference voltage reflecting the full magnetization condition of a permanent magnet in a predetermined rate. The magnetic display of a permanent magnet is generated as a function of the detected permanent magnet induced voltage, reference voltage, and a predetermined rate. When this magnetic display has reached the predetermined threshold, in order to avoid the damage to a component part, the above-mentioned motor is made into impossible of operation, and the current to/or the above-mentioned motor is

restricted. Preferably, the above-mentioned motor is made into impossible of operation, or an audible and/or visible drop reports operating in limit mode to the user of a car. Another source of power which are another desirable for example, motor, internal combustion engines, or those combination is considered as instead of [of the motor made into impossible of operation].

[0016]

[Embodiment of the Invention] This invention relates to an electric vehicle and a twist concrete target in a hybrid electric vehicle (HEV). Drawing 1 shows the configuration of the parallel / series hybrid electric vehicle by this invention (split type).

[0017] In HEV of drawing 1 , as for the epicyclic gear device 20, the carrier gear 22 is mechanically combined through an one-way clutch 26 to an engine 24. The epicyclic gear device 20 is combined mechanically [Sun Geer 28] on the generator motor (generator) 30 and the ring (output) gear 32 again.

[0018] The generator motor 30 is mechanically connected with the generator brake 34 again, and is electrically connected with a dc-battery 36. It is mechanically combined through the 2nd gearing device 40 to the ring gear 32 of the epicyclic gear device 20, and the promotion motor 38 is electrically connected with a dc-battery 36. The ring gear 32 and the promotion motor 38 of the epicyclic gear device 20 are mechanically combined through a power shaft 44 to a wheel 42.

[0019] The above-mentioned epicyclic gear device 20 divides engine output energy into the series path from the engine 24 to the generator motor 30, and the parallel path from an engine 24 to a driving wheel 42. An engine speed is controlled by changing the division degree to a series path, maintaining mechanical association through a parallel path. The promotion motor 38 assists the engine power to a driving wheel 42 on a parallel path using the 2nd gearing device 40. The promotion motor 38 sponsors directly the opportunity using the energy which is the free-running power which the generator motor 30 essentially generates from a series path again. The loss accompanying this changing electrical energy between the chemical energy in a dc-battery 36 is reduced, and what deducted conversion loss from the total energy from an engine makes it possible to reach to a driving wheel 42.

[0020] The car system control machine (vehicle system controller) 46 controls many component parts by combining with the controller of each component part in this HEV configuration. The engine control unit (carrying out engine control unit abbreviation ECU) 48 is combined through a wiring interface to an engine 24. Although ECU48 and VSC46 can be held in the same unit, it is desirable that it is a separate controller. a communication network [like the controller area network (carrying out controller area network abbreviation CAN) 54] whose VSC 46 is -- minding -- ECU 48 -- and it communicates again between the dc-battery control unit (carrying out battery control unit abbreviation BCU) 50 and the transformer axle management unit (carrying out transaxle management unit abbreviation TMU) 52. BCU 50 are combined to a dc-battery 36 through a wiring interface. TMU 52 controls the generator motor 30 and the promotion motor 38 through a wiring interface. More specifically, TMU 52 contains the controller which performs the program memorized in order to judge the torque of the generator motor 30 and the promotion motor 38. Moreover, according to this invention, TMU 52 detects and memorizes the magnetic display of the permanent magnet in the generator motor 30 and the promotion motor 38. Specifically, the voltage sensor included in the generator motor 30 and the voltage sensor of the promotion motor 38 judge the electrical potential difference proportional to the magnetism of the permanent magnet in the generator motor 30 and the promotion motor 38 which are explained below. Moreover, according to this invention, TMU 52 controls motor torque and a current, i.e., motor actuation, and displays warning to the user of a car.

[0021] Drawing 2 is some block diagrams of the transformer axle management unit 52 in which connecting with the generator motor 30 and the promotion motor 38 by the desirable operation gestalt of this invention was shown. As for TMU 52, it is desirable that a controller 100, a voltage monitor 102, a voltage monitor 104, an inverter 106, and an inverter 108 are included. An inverter 106 is connected to the promotion motor 38 in order to supply a three-phase-alternating-current current to the promotion motor 38. A three-phase-alternating-current current is changed from a direct current from a dc-battery 36. Similarly, an inverter 108 is connected to the generator motor 30 in order to supply a three-phase-alternating-current current to the generator motor 30. The three-phase-alternating-current current is also changed from a direct current from a dc-battery 36. An inverter 106 and an inverter 108 are connected to a controller 100, and in order to judge the current supplied to the generator motor 30 and the promotion motor 38, respectively, a signal is inputted into a controller 100 an inverter 106 and 108. According to this invention, a voltage monitor 102 is connected to the promotion motor 38 in order to judge the permanent magnet induced voltage of the promotion motor 38. Similarly, a voltage monitor 104 is connected to the generator motor 30 in order to judge the permanent magnet induced voltage in the generator motor 30. The permanent magnet induced

voltage from the promotion motor 38 and the generator motor 30 is used by the controller 100, in order to judge the condition of the permanent magnet held in the promotion motor 38 and the generator motor 30. Based on the condition of the permanent magnet in the promotion motor 38 and the generator motor 30, a controller 100 judges an inverter 106 and the current supplied by 108, judges whether the promotion motor 38 or the generator motor 30 can operate, and performs warning to a user.

[0022] As for a controller 100, it is desirable that a processor (treater) 110 and memory 112 are included. A processor 110 has one or a microprocessor beyond it, a microcontroller, etc. As for a controller 100, it is desirable to perform the program which memorized the display of the magnetic condition of the permanent magnet held in the generator motor 30 and the promotion motor 38 in order to judge, memorize and transmit. Moreover, as for a controller 100, it is desirable to perform the program memorized in order to judge the actuation which should be performed based on the magnetic condition of the permanent magnet held in the generator 30 and the promotion motor 38. Memory 112 contains most preferably the nonvolatile memory components which memorize the display of the magnetic condition of the permanent magnet in the generator motor 30 and the promotion motor 38.

[0023] As for a voltage monitor 102 and 104, it is desirable that a voltage sensor 114 and a voltmeter 116 are included. In order to judge permanent magnet induced voltage at the rate of [of a motor 30 and 38] predetermined, direct continuation of the voltage sensor 114 is carried out to each motor. A voltmeter 116 supplies a voltage signal to a controller 100 from a voltage sensor 114, in order to use it, in case the magnetic condition of the permanent magnet in the generator motor 30 and the promotion motor 38 is judged. Preferably, a voltmeter is held in the outside of a motor. A voltmeter is hardware which has already existed in a car, and it is most desirable that it is what is reused for the magnetic monitoring function which it is [only being needed for a periodic target and].

[0024] Drawing 3 is the sectional view of the generator motor 30 containing the desirable voltage sensor by this invention. The same configuration is desirable also about the promotion motor 38. The generator motor 30 contains a rotor 200 and a stator 202. A permanent magnet 208 is attached in a rotor 200. The coil 204 (illustrated between two stator gear teeth) of a motor is coiled around the surroundings of a gear tooth 205 in the general mode in the slot 206 of a stator 202. According to this invention, the sensor coil 210 is wound around the surroundings of the gear tooth 205 in the slot 206 of a stator 202. As for the sensor coil 210, in the edge of the gear tooth 205 nearest to the clearance between a stator 202 and a rotor 200, it is [like] desirable to adjoin a rotor 200 and to be arranged [which is shown in drawing 3]. The sensor coil 210 is very thick and it is desirable to have a wire with few number of turns. It connects with a voltmeter 116 and the sensor coil 210 functions as a voltage sensor 114. The sensor coil 210 is used in order to judge the permanent magnet induced voltage in a generator 30. When a current does not flow to motor winding 204, more specifically, an electrical potential difference is guided to the sensor coil 210 by the magnetic field which rotation and the permanent magnet 208 of a rotor 200 generate. This electrical potential difference is detected by the voltmeter 116, and is transmitted to a controller 100.

[0025] Drawing 4 is a flow chart which shows how to judge and cope with degradation of the permanent magnet in the motor by this invention. It explains below, referring to an above-mentioned desirable operation gestalt [in / for this approach / drawing 1 thru/or 3].

[0026] First, the permanent magnet induced voltage of a motor is judged (step 300). In a desirable operation gestalt, this is made by guiding an electrical potential difference to the sensor coil 210 at the period when the current is not flowing to the coil of a motor, i.e., a no-load period. Preferably, a voltmeter 116 quantifies the electrical potential difference guided to the sensor coil 210. When the current in the stator coil of a motor is zero, unloaded condition arises. For example, when there is the car, for example, it has stopped at the idle state with the stop signal, and when a car is in a fixed-speed condition and there is no current in motor winding, unloaded condition arises. The unloaded condition of another example is produced when having not received torque from an engine, in order for the generator motor not to supply torque to a wheel or to charge a dc-battery. As for permanent magnet induced voltage, it is desirable to be guided by rotation of the rotor 200 containing a permanent magnet 208. This generates the magnetic field which guides an electrical potential difference to a sensor coil. Most preferably, a rotor 200 is rotated at the rate of predetermined, and the contact of the inverter which supplies a current to a motor is wide opened during measurement of permanent magnet induced voltage. It judges whether it is desirable that what kind of condition is acquired through TMU 52 and the means for which the measurement stage of permanent magnet induced voltage, CAN 54, or others was [the controller 100] more specifically suitable in view of the condition of a car.

[0027] Permanent magnet induced voltage is proportional to the rotational speed of a magnetic field (bundle) and a rotor. Then, the reinforcement of a permanent magnet will be easily obtained, if a rate and

permanent magnet induced voltage are known.
[0028] After permanent magnet induced voltage is detected, permanent magnet induced voltage is in a condition without demagnetization, and is compared with the reference voltage reflecting the permanent magnet induced voltage in the same predetermined rate as the time of permanent magnet induced voltage being detected (step 302). That is, reference voltage is the value of the permanent magnet induced voltage expected when the permanent magnet is magnetized completely. As for reference voltage, it is desirable that TMU 52 memorizes. The difference between reference voltage and the detected permanent magnet induced voltage is used for judging extent of degradation of a permanent magnet. In order to refer to extent of this degradation in the future, it is desirable that a nonvolatile memory memorizes (step 304). Moreover, this magnetic field strength is measured with the 1st threshold in order to judge whether the permanent magnet reached even the deteriorating point that preliminary warning should have been made (step 306). When magnetic field strength is less than the 1st predetermined threshold most preferably, a display is made through audible or the visible display transmitted by CAN 54 to the user of a car (step 308). Moreover, in order to make the torque by which the current to a motor is restricted to the magnitude which avoids the damage to the component part of a car (step 308), and it is needed for/or a motor supply, TMU 52 is proofread so that an inverter may be driven more to accuracy. The 1st threshold is chosen as the appearance in which the actuation to which the car was limited at least is possible most preferably. While limit actuation is continuing, degradation of a permanent magnet is supervised with other motor parameters (for example, temperature) (step 310). The result of the further monitor in step 310 is compared with the 2nd threshold (step 312). This threshold is level, magnetic temperature, or another magnetic parameter supervised. When having not reached the 2nd threshold in step 312, a monitor continues (step 310). When having reached the 2nd threshold in step 312, the continuing motor actuation is postponed and it is warned of the user of a car with an audible or visible drop (step 314). When another source of power is available, it changes to the source of power as a driving source of a wheel (step 316). For example, in the desirable operation gestalt of drawing 1 , if the generator motor 30 becomes impossible of operation owing to degradation of a permanent magnet, a wheel 42 will be operated by the basis of control of the promotion motor 38. Moreover, a wheel 42 will be operated by the basis of control of the generator motor 30 and an engine 24 if the promotion motor 38 becomes impossible of operation owing to degradation of a permanent magnet. Most preferably, when the promotion motor 38 is impossible of operation, the generator motor 30 is used for driving a wheel 42 to a certain amount of rate first, and in order to heighten power through smooth shift, an engine 24 is operated.
[0029] In the desirable alternative of the above-mentioned approach about drawing 3 , the 1st and the 2nd threshold are changed into the same value, or one side or another side is disregarded. For example, the attainment (step 312) to a magnetic threshold may lose steps 306 and 308 so that a motor may be immediately made into impossible of operation (step 314). Instead, if degradation of a magnet does not cause impossible of operation or a non-insurance condition, step 310, 312, and 314 and 316 may be lost.
[0030]
[Effect of the Invention] As mentioned above, this invention can offer the easy and effective method of judging the condition of the permanent magnet in the motor of a car. A magnetic condition is compared with the threshold on insurance, and the problem of a safety aspect is indicated available at the user of a car. Moreover, this magnetic condition is used, and the current to the motor by which the torque from a motor is proofread is restricted, the actuation from a motor is postponed, or it is switched to another power.
[0031] The above-mentioned operation gestalt of this invention is a thing for the purpose of instantiation purely. Otherwise about this invention, many modifications, amelioration, and an application can be considered.

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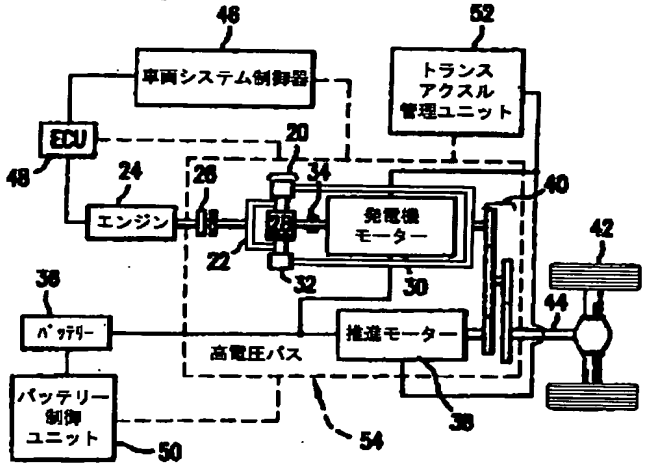
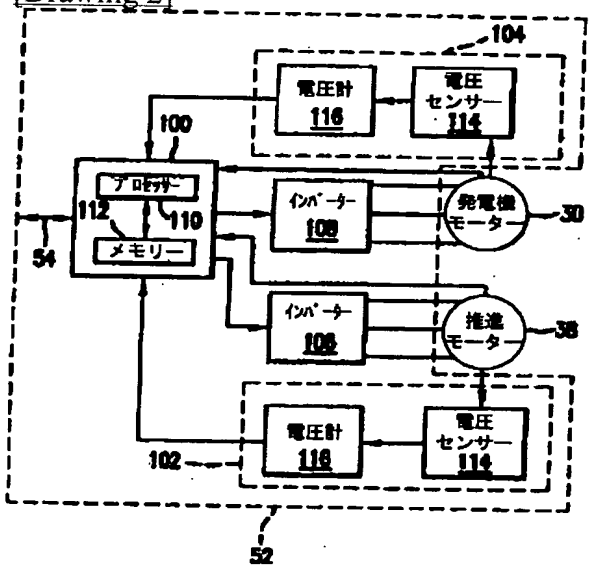
DRAWINGS

[Drawing 1]



[Drawing 2]



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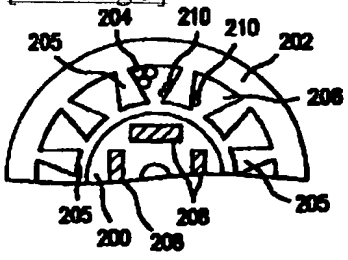

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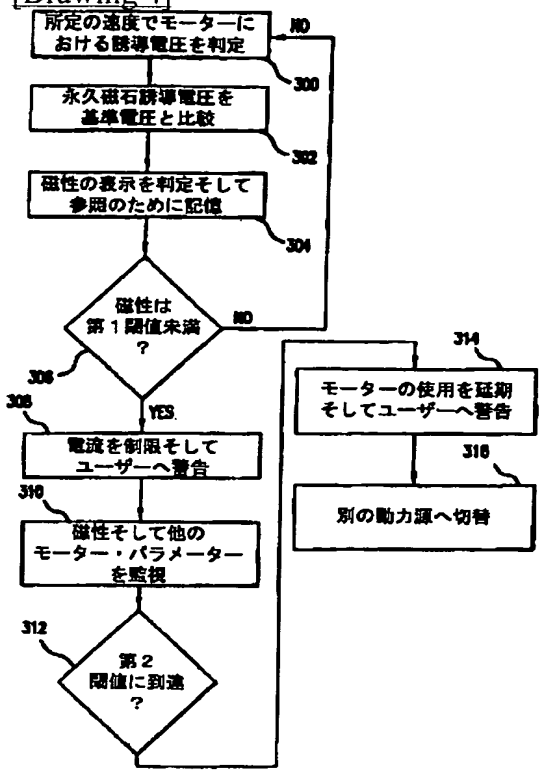

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